



**FOREIGN  
BROADCAST  
INFORMATION  
SERVICE**

# ***JPRS Report***

# **Science & Technology**

***Japan***

19980630 122

**DISTRIBUTION STATEMENT A**

**Approved for public release;  
Distribution Unlimited**

REPRODUCED BY  
U.S. DEPARTMENT OF COMMERCE  
NATIONAL TECHNICAL INFORMATION SERVICE  
SPRINGFIELD, VA. 22161

# Science & Technology Japan

JPRS-JST-89-015

## CONTENTS

16 August 1989

### AEROSPACE, CIVIL AVIATION

Development of Automatic Lattice Generation Method [Susumu Takanashi; KOGIKEN, Feb 89]	1
International Joint Research in VAMAS [Yoshio Noguchi; KOGIKEN, Feb 89]	2
High Temperature Differential Basic Testing and Evaluation Device [Shocho Kumagawa; KOGIKEN, Feb 89]	3

### BIOTECHNOLOGY

Biotechnology Research Center Developments	5
Nippon Roche To Establish Microbial Research Center [JAPAN CHEMICAL WEEK, 25 May 89]	5
Nippon Steel Starts Biotechnology Research Room [JAPAN CHEMICAL WEEK, 25 May 89]	5
Blood Coagulation Factor VIII Prepared by Genetic Recombination [JAPAN CHEMICAL WEEK, 11 May 89]	5
High-Performance DNA-Synthesis Reagent Marketed [JAPAN CHEMICAL WEEK, 4 May 89]	5
National Liaison Organization for Bioindustry To Be Formed [JAPAN CHEMICAL WEEK 29 Jun]	6

### COMPUTERS

MITI's FY89 Information Society Projects [DENSHI KOGYO GEPPU, Mar 89]	7
---	---

### DEFENSE INDUSTRIES

IHI Makes Comeback in Weapons Manufacture [ZAIKAI TENBO May 89]	14
---	----

### NUCLEAR ENGINEERING

Construction Begins at Shiga Nuclear Power Plant [H. Sato; DENKI TO GASU, Feb 89]	19
---	----

### TECHNOLOGY TRANSFER

Additional Japanese Aid To Chemical Plant [TIMES OF ZAMBIA, 2 Jun 89]	22
---	----

### Development of Automatic Lattice Generation Method

43062060a Tokyo KOGIKEN in Japanese  
Feb 89 pp 1-3

[Article by Susumu Takanashi of the Aerodynamic Performance Department]

[Text] An automatic method of lattice generation has been developed as a first attempt at putting a numerical wind tunnel into black box form; the main points are introduced here.

A number of lattice generation methods have been proposed in the past; most of these have used differential equations, integral equations or algebraic equations. However, it is not really necessary to use equations to generate a lattice in a space. Lattice points can be distributed in space by quantifying a lattice's properties of orthogonality and slipperiness, then minimizing the weighted average values of those quantities. If these rules of distributing lattice points can be taught to a computer, it will be possible to generate lattices automatically, without human intervention. The biggest problem is how to assign weights; weight constants are decided by applying the following sorts of restraint conditions: (1) designated values are taken for initial lattice intervals on lattice lines projecting perpendicularly from the material; (2) lattice points exist only in the region between the material and the far boundary; (3) the lattice intervals in the space must be at or above the admissible values.

The data to be input by the user are (1) lattice point coordinates on the aircraft surface, (2) data on the shape of the far boundary, (3) the total number of lattice points, (4) the Reynolds number or minimum lattice interval at the aircraft surface, and (5) the minimum admissible lattice interval in the space.

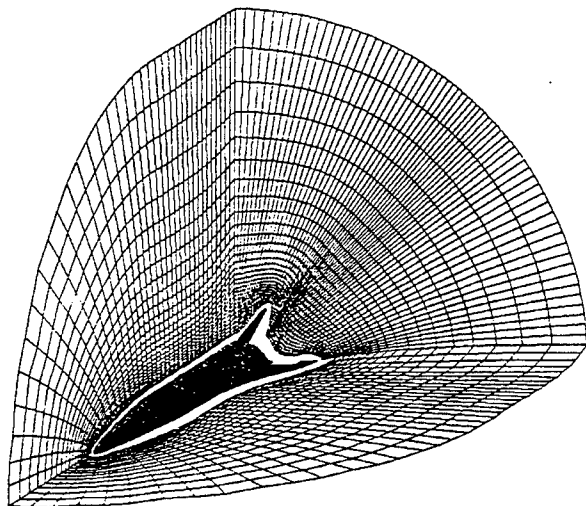


Figure 1. Space Lattice Surrounding Space Plane

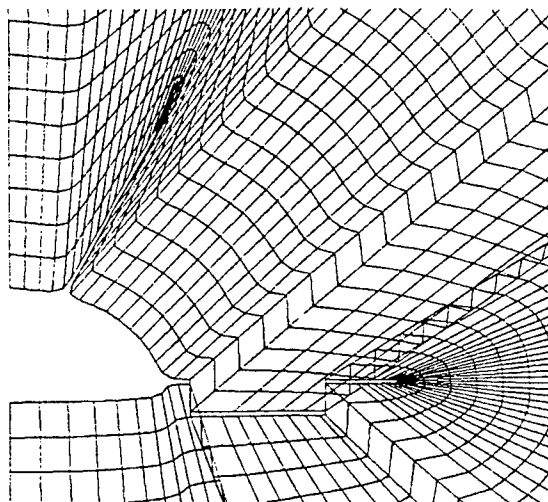


Figure 2(a). Initial Lattice

An example of application is described next. The shape dealt with is a high-speed wind test model of the space plane now in research at the National Aerospace Laboratory. It consists of a fuselage, strakes, wings, oblique tail planes and elevons. Figure 1 is a bird's-eye view of a space lattice ( $37 \times 100 \times 50$ ) with the elevon depressed 30 degrees. About  $110 \times 120 \times 50$  lattice points are needed for an actual Navier-Stokes calculation. Figure 2(a) shows the initial lattice for a cross section perpendicular to the axis of the aircraft. Anything will do for the initial lattice, but in this example the surface lattice points and the outer boundary are connected by straight lines that are divided into equal intervals. The lattice lines cross each other close to the tail plane and elevon. When such an initial lattice is optimized using the method under discussion, a slippery lattice with superior orthogonality is generated, as in figure 2(b).

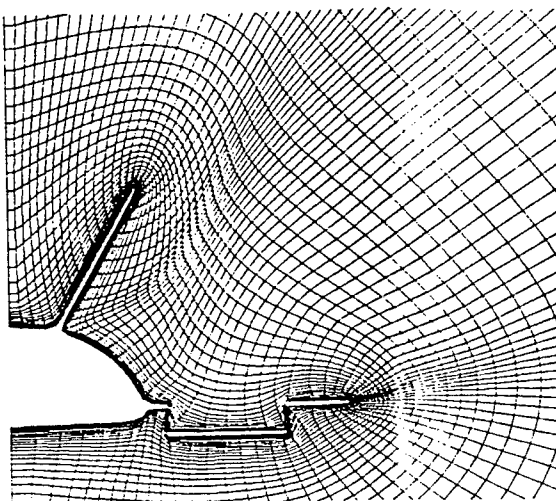


Figure 2(b). Lattice Generated by Optimization

A lattice obtained in this way can be applied to actual Navier-Stokes calculations, and yields a high-precision numerical analysis that stands up to comparison with data from wind tunnel experiments. Figure 3 shows oil flow drawn on the aircraft surface when  $M$  equals 1.5 and  $\alpha$  equals 15 degrees.

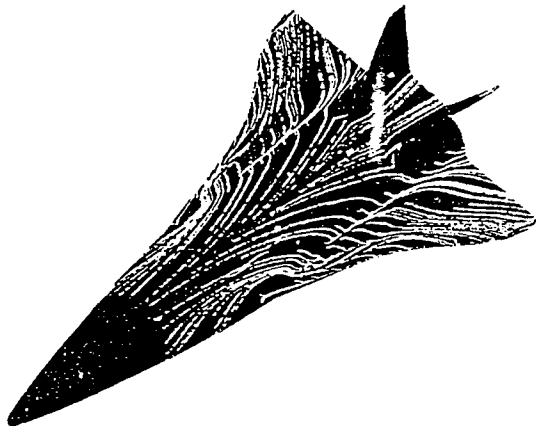


Figure 3. Oil flow pattern obtained by Navier-Stokes simulation ( $M = 1.5$ ,  $\alpha = 15^\circ$ )

The example shown here uses a relatively simple shape, but there is no procedural obstacle to using it with more complex shapes that include engine nacelles, pylons and canards. It is also very easy to generate a solution-adapted lattice in which the lattice lines are concentrated by severe changes in airflow, as in the case of shock waves. Consequently, this method of lattice generation is expected to show its power when the numerical wind tunnel is applied to airframes of a variety of aircraft.

#### International Joint Research in VAMAS

43062060b Tokyo KOGIKEN in Japanese Feb 89 pp 1-3

[Article by Yoshio Noguchi of the Airframe Department]

[Text] VAMAS is the acronym of the Versailles Project on Advanced Materials and Standards; it is one of the projects established under agreements at the 1982 Versailles Summit. The purpose of this proposal was to do R&D to establish the technology necessary to set specifications and standards for use of new materials, on the foundation of international coordination, and to promote the practical application of new materials.

The VAMAS project has gone forward through the cooperation of the research entities of the summit participants: Britain, the U.S., West Germany, France, Italy, Canada, Japan and the EC.

In Japan the VAMAS project has been handled as general research under the Science and Technology Promotion and Coordination Fund of the Science and Technology Agency, since FY 1986, and has been budgeted under the name "International Joint Research on

Technology for Testing and Evaluation of New Materials; there has been actual research and a series of surveys. The research period is five years in two phases (from 1986 through 1988 and from 1989 through 1990). The names of 13 current research topics and the sponsoring countries are listed in table 1.

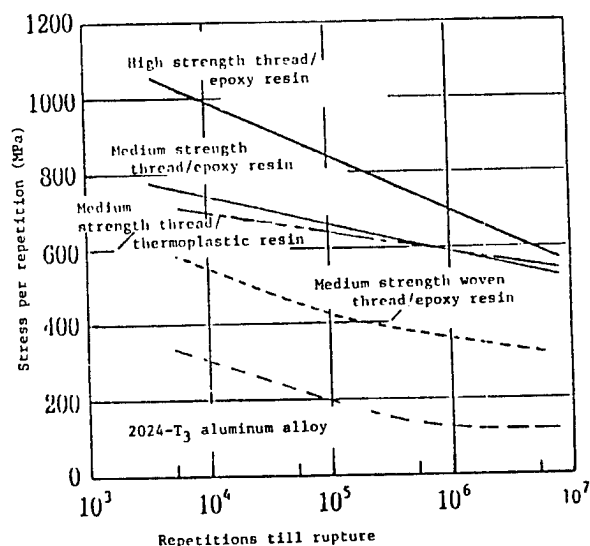
Table 1. VAMAS Topics

	Name	Sponsor
1	Wear testing and evaluation technology	West Germany
2	Surface chemical analysis testing and evaluation technology	U.S.
3	Engineering ceramics	France
4	High polymer mixture materials	Canada
5	High polymer composite materials	France
6	Superconductive and cryogenic materials	Japan
7	Biotic materials	Italy
8	Molten salt corrosion testing and evaluation technology	Britain
9	Welding characteristics	U.S.
10	High-temperature mechanical properties testing and evaluation technology	Britain
11	Efficient testing of high polymer materials	Britain
12	Mutual use of materials databases	EC
13	Low cycle rupture test technology	EC

The Aircraft Parts Composite Structure Laboratory is participating in the high polymer composite materials topic, and is conducting research to establish test methods for rupture and for fracture toughness of fiber-reinforced plastics (FRP).

Research on rupture testing includes accumulation of materials to be used in consideration of evaluation technology, such as test sample shape and size, acquisition of samples, repetitive load size and rupture longevity, all in regard to layered carbon fiber reinforced plastics (CFRP) of various structures, in order to contribute to rupture test methods to measure tensile strength and bending strength. It also includes methods to track the progress of damage during rupture testing using non-destructive inspection equipment.

As one example of bending strength evaluation, Figure 1 shows the results (in terms of repeated stress and number of repetitions till rupture) of a rupture test of planar bending strength of cross-layered CFRP using different kinds of carbon fiber as the reinforcing material. Collection of this sort of data on rupture characteristics of



**Figure 1. Results of Planar Bending Rupture Testing of Cross-Layered CFRP**

different types of layered structures is necessary for the study of composite materials testing and evaluation technology.

In research on rupture toughness, there have been tests of the strength against separation of layers of CFRP and common samples for international joint research (glass fiber reinforced plastic: GFRP), and research on methods to determine rates of energy emission.

Establishment of highly reliable methods for testing and evaluation of mechanical characteristics is urgently needed in order to fully exploit the properties of fiber reinforced composites as designable industrial materials. By shedding light on the environmental factors that affect them and by assuring the reliability of measurements, it will be possible to optimize designs, assure safety, and contribute to energy conservation by making materials lighter.

#### High Temperature Differential Basic Testing and Evaluation Device

43062060 Tokyo KOGIKEN in Japanese Feb 89 pp 4-6

[Article by Shocho Kumagawa of the Kadota Institute]

[Text] The National Aerospace Laboratory and 16 other research institutes throughout Japan have joined in "research on basic technology for the development of functionally gradient materials to ease thermal stress," since FY 1987, under the Science and Technology Promotion and Coordination Fund. In connection with technology for evaluation of thermal isolation characteristics of functionally gradient materials, the Aerodynamics Department, the Thermal Fluid Dynamics

Department and the Kadota Institute have conducted research directed at their respective environments: aerodynamic heating, rapid rotation heating and combustion gas heating.

Of these actual environments, let us first look at the thermal environmental conditions of the scramjet, a space shuttle propulsion system. The temperature of the combustion gases in scramjets exceeds 2000 K, causing severe heating of the combustion chamber walls. The thermal flux against the surface of the walls is expected to reach 5 MW/m<sup>2</sup> or more. To maintain materials exposed to such high thermal flux at tolerable temperatures, it is necessary to actively cool them, perhaps with the liquid hydrogen used as a fuel. Consequently, the cool side of the material is exposed to liquid hydrogen with a low temperature of 20 K and a high pressure of about 100 atmospheres. This creates a great temperature difference across the material of the wall. Thus, the material of the engine must withstand very high temperatures, high thermal loads, very low temperatures and high pressure, and it must withstand the great thermal shock caused by those conditions. It must also have the durability and longevity to be used for several hundred flights. Conventional ceramics and heat-resistant metals each have their own strengths and weaknesses when it comes to meeting all these harsh requirements. Functionally gradient materials that ease thermal shock have been devised to overcome the weaknesses; it is the role of the National Aerospace Laboratory to evaluate the manifestation of these functions under conditions as close as possible to the actual environment.

The research on functionally gradient materials is divided into two phases. In the first phase, the objects of research are small samples (30 mm in diameter, 1 to 10 mm thick). Initially, lasers and combustion gas burners were considered as means to apply a steady thermal load to these small samples. A high thermal flux can be obtained by the laser heating method, but the area heated is much smaller than the samples in question. The combustion gas burner method can heat a large area, but the thermal flux is low, and there is also the problem of oxidation. And because the samples were cooled with liquid hydrogen, it was necessary to give consideration to safety measures in the event the samples broke, as well as to the precooling time and the problem of freezing after completion of the test. In the first phase it is important that the evaluation emphasize whether the function of easing thermal shock is manifest well. With that in mind, it was decided to build a device for basic testing and evaluation of high temperature differentials.

The purpose of this device is to apply high thermal loads and high temperature differentials to samples of functionally gradient material. It is made up of a 30 kW xenon arc lamp for heating, liquid hydrogen supply lines for cooling, a vacuum exhaust system to maintain a vacuum around the sample and to safely exhaust the hydrogen to the open air in the event of breakage, and

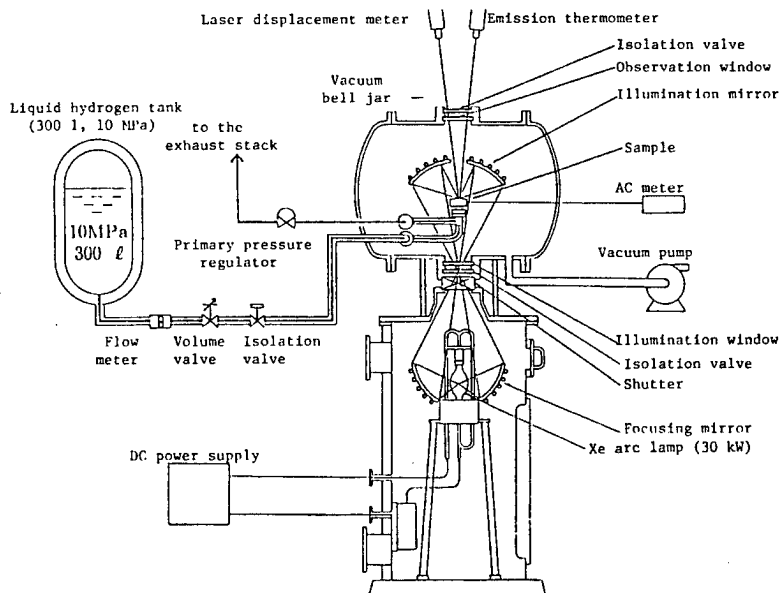


Figure 1. High temperature differential basic testing and evaluation device

instrumentation and control equipment. Of those components, the liquid hydrogen supply system and the vacuum exhaust system are the same as those used in earlier research on liquid oxygen/liquid hydrogen rocket burners. A diagram of the device appears in figure 1, and a photograph of the interior of the vacuum bell jar is given as figure 2. The major capacities of the device are listed below:

- |     |                             |                           |
|-----|-----------------------------|---------------------------|
| (a) | Maximum thermal flux        | 6 MW/m <sup>3</sup>       |
| (b) | Maximum surface temperature | 2100 K                    |
| (c) | Attained vacuum             | 5 x 10 <sup>-3</sup> torr |
| (d) | Heating possible in maximum | 0.3 Hz steps              |

Tests of the device have been conducted using samples prepared with existing materials and existing technology. A photograph of a ceramic sample broken by thermal stress is given as figure 3.

This device is to be used to expose small samples of functionally gradient materials to maximum surface temperatures of 2000 K and temperature differentials of 1000 K, and to evaluate their thermal insulation characteristics, structural soundness and ability to ease thermal shock, and to test low-cycle thermal fatigue. Basic evaluation testing of scramjet cooling structural panels, using this device, has also been planned.

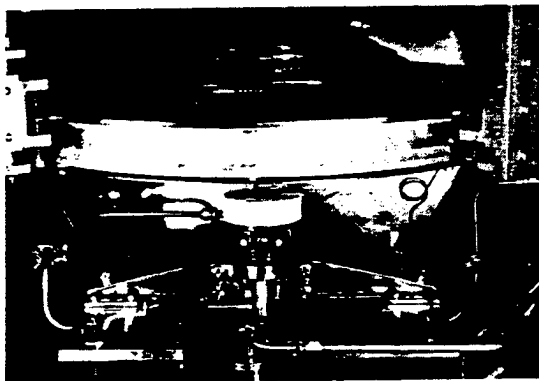


Figure 2. Interior of vacuum bell jar

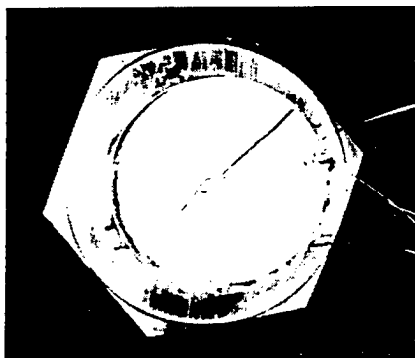


Figure 3. Cracked ceramic sample

## Biotechnology Research Center Developments

### Nippon Roche To Establish Microbial Research Center

43073906 Tokyo JAPAN CHEMICAL WEEK in  
English 25 May 89 p 4

[Text] Nippon Roche K.K. is planning to double the size of its Kamakura Research Institute at a total cost of ¥ 5-6,000 million: the company will build a new laboratory having the same size as the existing one with completion scheduled for the end of next year.

The new laboratory will serve as a microbial research center for the Roche group and focus on searching for useful substances contained in microorganisms and natural products. It will also act as an R&D base for drugs, vitamins and biotechnology.

The institute will be further scaled up some time in the future to the point where it is able to conduct research on fine chemicals and liquid crystal as well as drugs and vitamins.

It was built in 1972 on a 9,000-m<sup>2</sup> site located in Kamakura, Kanagawa Prefecture and is now staffed with researchers numbering approximately 270. It can compare with three other major Roche research institutes located in Basel (Switzerland), New Jersey (United States) and Welwyn (U.K.).

It has developed promising antibiotics, antibiotics-based agents effective against malignant tumors and veterinary drugs. The antibiotics have already been put into clinical tests and the institute will decide—by the fall of next year—whether it will inaugurate clinical tests on the agents. It has found physiologically active substances—potential drugs—in natural products.

### Nippon Steel Starts Biotechnology Research Room

43073906 Tokyo JAPAN CHEMICAL WEEK in  
English 25 May 89 p 4

[Text] Nippon Steel Corp., the world's largest steel maker, has started Biotechnology Development Room at its No 1 Technology Research Laboratories in Kawasaki in a bid to build up its setup for carrying out biotechnology-research and applied business for itself.

The company has already tied up with Calgene, Inc. (United States) on biotechnology R&D, begun seed-and-seedling business for flowers and vegetables, and taken part in a joint research project for mass breeding of expensive fishes capable of living in cold waters, a joint marine biotechnology research project and a large bionursery project supported by the Ministry of Agriculture, Forestry and Fisheries.

The new room has begun operating with 10-odd researchers, with plant biotechnology, and microbial and enzymatic research as the chief target areas for the moment.

### Blood Coagulation Factor VIII Prepared by Genetic Recombination

43073907 Tokyo JAPAN CHEMICAL WEEK in  
English 11 May 89 p 4

[Text] Teijin Ltd. and The Chemo-Sero-Therapeutic Research Institute have jointly succeeded in producing a blood-coagulation factor VIII preparation by means of genetic recombination for the first time in Japan. This method features a higher yield of the activated factor VIII than that achieved by two U.S. companies.

In the new method, about one-third of a gene for making the substance in question is taken out to reduce the molecular weight of the substance to be produced, since this part—termed "B domain"—has been found to have nothing to do with the action of blood coagulation. The gene minus B domain was combined into a vector to reform a plasmid, which was implanted into the ovarian cells of a Chinese hamster for cultivation.

It has been confirmed that factor VIII was produced in the cells after cultivation and it develops activity similar to that of conventional plasma-source factor VIII.

Blood-coagulation factor VIII has a molecular weight of as high as about 330,000 and it has thus been believed difficult to mass-produce it efficiently by means of genetic recombination, although this method should assure stable supplies of the virus-free factor, if practised successfully. In the United States, Genentech Inc. and Genetics Institute separately announced in 1984 that a gene specifying the factor in question has 2,332 bases and thereafter succeeded in producing it by means of recombination of the gene.

This method, however, has a problem with regard to production yield which is very low because of the large molecular weight of the substance. The Japanese method, on the other hand, features a much higher yield as seen from the remark of a Teijin official: "It is in the order of several hundred times that in the case of using the Genentech process." The only problem with the substance produced in this way is that it is not the same as that produced in the body, indicating the possible occurrence of side effects.

### High-Performance DNA-Synthesis Reagent Marketed

43073908 Tokyo JAPAN CHEMICAL WEEK in  
English 4 May 89 p 8

[Text] Toagosei Chemical Industry Co. has begun to market an inhouse-developed DNA-synthesis reagent having markedly high cost performance. It is a combination of thiophosphite (sulfur/phosphor compound) and tin-based catalysts.

The new product has these features: (1) high yield ratio of 99.5 percent, (2) high reaction speed and (3) good storage stability.

The company envisages supplying it to laboratories and research organs and attaining annual sales of roughly ¥1,000 million three years hence, thereby commanding 30 percent of the world market for DNA-synthesis reagents.

The reagents are used for synthesizing DNA of comparatively short length: they link short DNAs with each other to form longer DNA and identify targeted DNA among many types of DNA.

They are classified into triester-, phosphoramidite- and H-phosphonate-process products in accordance with the synthesis processes they proceed.

The new reagent is the first thiophosphite-process product.

#### **National Liaison Organization for Bioindustry To Be Formed**

43073909 Tokyo JAPAN CHEMICAL WEEK in English 29 Jun 89 p 4

[Text] Bioindustry Development Center (BIDEC) will set up a national liaison office connecting major local bioindustry-related organizations by October at earliest.

By establishing the liaison office BIDEC intends to help promote the extensive development of bioindustry across Japan, create new markets, make appropriate allotment of funds to local bodies and construct facilities open to local researchers and residents. The new organization is expected to be participated in by nine organizations involved in bioindustry covering the main regions of Japan—one each in Hokkaido, Tohoku, Kanto (BIDEC), Chubu, Kinki, Chugoku, Shikoku, and Kyushu, and one organization for development of local industries.

BIDEC hopes that the new organization will serve to promote information exchange and understanding of R&D and application efforts among bioindustry-related bodies and groups of the private, academic and government sectors. It is also expected to help enhance relationships with foreign organizations involved in bioindustry.



**MITI's FY89 Information Society Projects**  
*43065151 Tokyo DENSHI KOGYO GEPPU in Japanese Mar 89 pp 2-11—FOR OFFICIAL USE ONLY*

[Summary by Electronics Policy Division of MITI's Machinery and Information Industries Bureau]

[Text] Introduction

The information orientation of Japan has made steady progress; there are 300,000 general-use computers in operation, and over 68 percent of all enterprises have gone online. The wave of information orientation is expected to spread rapidly from the field of industry to the social field, and to broadly penetrate the home in what is called "the personalization of information."

The coming highly information-oriented society will be a society of which all fields are linked by networks, in which necessary services are available to be enjoyed anywhere. A variety of economic, social and cultural activities will be systematized and raised to higher levels, and a more abundant life is anticipated.

The information industry that supports this turn to information has already grown to an 18 trillion yen industry that leads Japanese industry, and continued high growth can be predicted. A report by the Long-term Prospects Subcommittee of the Information Industry Committee of the Industrial Structure Council states that by 2000, the information industry will grow to a 126 trillion yen industry that accounts for 20 percent of GNP, and will literally be a leading industry that will open up the 21st century.

On the other hand, because Japan's turn to information has been centered on quantitative expansion accompanying rapid technological innovation, there are still fundamental and qualitative problems and accurate responses to these tasks are desired to bring about a highly information-oriented society.

From that perspective, MITI will continue development of comprehensive policies on information use during FY 1989.

New measures are introduced below, together with policies on information use that MITI is already promoting.

**Response to the Software Crisis and Promotion of Information Education and Development of Human Resources**

In order to solve the marked imbalance of software supply and demand (the software crisis), which will be the biggest problem in bringing about a highly information-oriented society, it will be necessary to devise comprehensive support measures for projects to strengthen regional software supply bases.

Another urgent task is to promote the use of computers in schools and to foster human resources to support the turn to information in various fields of industry and society, in order to meet the information processing needs of industry and society which will be diversified and raised to higher levels with the advance of the turn to information.

In FY 1989 we will take new steps to strengthen regional software supply bases, and will continue comprehensive measures on information education and the training of human resources.

1. Strengthening regional software supply bases (Project to Raise the Level of Regional Industrial Information Use): In order to solve the marked imbalance of software supply and demand (the software crisis), it will be necessary to devise comprehensive support measures for projects to strengthen regional software supply bases.

Therefore, Centers to Raise the Level of Regional Industrial Information Use (provisional name—Third Sector companies and non-profit organizations) will be set up to promote the following projects in locations across the country.

- (1) Fostering software talent (High-level training of regional software technicians)
- (2) Strengthening of software technical base (fixation of the Advanced Software Development System (Sigma System) in outlying areas)
- (3) Expansion of project opportunities in software industry (facilitation of joint orders)

The projects conducted by these centers will will receive financial support and guidance from the Information Technology Promotion Agency (IPA). MITI and the Ministry of Labor [MOL] will cooperate in support of fostering software talent.

-Budget 60 million yen (new) Project to Raise the Level of Regional Industrial Information Use

-Public investment 1 billion yen (new) Project to Raise the Level of Regional Industrial Information Use Industrial Development Special Account

There will also be investments and grants from the Industrial Investment Fund (NTT interest-free financing) and the MOL's Employment Promotion Corporation.

2. Promotion of the Information College concept: In order to foster human resources in cooperation with industry and to invigorate the regional training of technical personnel, we will train instructors to study methods of training software technicians and engage in information processing education at the Central Institute of Information Education (affiliated with the Japan

Information Processing Development Association). The best regional information processing education institutions will become "cooperating institutions for the education of information-oriented human resources (Regional Information Colleges)" to promote the concept, and will spread superior teaching methods throughout the country.

-Budget 110 million yen (80 million yen in 1988) Promotion of Information College concept

We will also promote development of courseware for training of software technicians (CAROL system) in cooperation with the IPA.

-Public investment 600 million yen (900 million yen in 1988) Development of Courseware for Software Technician Training Industrial Development Special Account

3. Promotion of computer use in schools: Now that the turn to information is progressing rapidly, it is necessary to remove obstacles to the use of computers and other information equipment by a broad range of Japanese of all classes (promotion of computer literacy). It has been requested, therefore, that computers be easily introduced into the schools so that children can adopt computers as natural tools. In addition, much is expected of education using computers as an effective means of diversification of teaching methods.

From that perspective, we will work to promote the use of computers in the schools, with efforts focused on the IPA's Computer Education Center (CEC).

The Basic Technology Survey of Information Processing for Schools will implement a basic survey and R&D on easily-used computers for use in the schools, in order to promote the use of computers in the schools.

-Budget 260 million yen (240 million yen in 1988) Basic Technology Survey of Information Processing for Schools

4. Preparation of a system for smooth development and supply of software: A stable supply of good software is an essential condition for bringing about a highly information-oriented society. At present, however, the rapid progress of information use, or the rapid popularization of computers, has brought about an explosive increase in the demand for software. On the software production side, on the other hand, the information processing technicians involved in software development have fallen into a state of chronic shortage. As a result, it is expected that the gap between supply and demand will grow greater and greater into the future, to the point that no recovery is possible. Moreover, the proportion of software-related costs within total information processing costs is steadily increasing, and there are strong demands for software with improved reliability and quality. In this sense, the climate surrounding software development has become a harsh one.

Therefore, we will continue to actively promote the Sigma project in IPA, which is the core promotion organization for software measures, and we will implement comprehensive software measures including use of a programming reserve fund system which is indispensable for making programs generally usable.

Projects conducted by IPA: (a) Industrialization of software production (Sigma project), this will create a system to improve the productivity of software development. (b) Promotion of program development and distribution; this will develop and popularize programs in such important fields as applications for personal computers standardized for education. (c) Study of evaluation of software quality. (d) Promotion of the development of advanced information processing technology; this will deal with development of the next generation of software development technology. (e) Promotion of information use by small businesses; this will deal with the development of a simple document input system for small businesses and small business information systems.

-Budget 1.33 billion yen (1.20 billion yen in 1988) Information Technology Promotion Association Project Costs

-Public investment portion of 5.0 billion yen (portion of 5.3 billion yen in 1988) Information Technology Promotion Association Project Costs

#### **Formation of Network Companies and Preparation of Information-oriented User Base**

1. Maintaining interoperability of information-related machines and systems: Interconnection among computers has expanded with the development of information and communications technology. But from the perspective of smooth progress in the turn to information and the preservation of free competition among equipment and systems manufacturers, there are now strong demands for preservation of interoperability among information-related machines and systems.

Therefore, to maintain interoperability on both the hardware and software levels, we will make a multifaceted response that includes unification of business protocols (information exchange and processing arrangements for business) at the industry level, and also creation of JIS [Japanese Industrial Standards] on OSI (Open Systems Interconnection) carried out within ISO (International Standards Organization), development of advanced technology to maintain interoperability, and international cooperation.

(a) Promotion of OSI through international cooperation: (i) Implementation of government to government international cooperation, such as holding Japan-EC high-level and expert-level meetings on promotion of OSI; (ii) Liaison among POSI (Japan), SPAG (EC) and COS (US), which are the private-level organizations promoting OSI.

(b) Efforts to test the compatibility of products that conform to OSI: Compatibility tests for information processing machines and other products conforming to OSI are being studied in the OSI Testing and Verification Center within the Interoperability Technology Association for Information Processing (INTAP).

We will also survey the extent of the spread computer interconnection.

-Budget 30 million yen (new) Survey of Spread and Promotion of Computer Interconnection

(c) R&D on computer-interoperable database systems: To bring about a highly information-oriented society, it will be necessary to build large-scale database systems such that multimedia information including text, drawings, images and sound can be efficiently exchanged among different types of information-related equipment.

Therefore, we will carry out full-scale design and production of high-level and advanced information systems technology, including multimedia technology, distributed database technology and high-reliability technology, as a part of R&D on "Computer-interoperable Database Systems," created in FY 1985 as a large-scale project.

-Budget 1.42 billion yen (1.14 billion yen in 1988) Development of Computer-interoperable Database Systems

2. Response to personalization of information: To promote the high-level use of information, it will be necessary to popularize, individualize and diversify information systems, and to provide human interfaces so that general users in all fields can operate computers without feeling out of place.

However, present computers can only be used by experts, and it is difficult to process unformatted information or analog information. If that situation continues, it will generate a large mass of people who cannot use information equipment, which will obstruct the smooth attainment of a highly information-oriented society.

To deal with that problem by bringing about the personalization of information (a super-distributed information processing environment), it will be necessary to develop (1) technology to process image and other analog information, (2) technology to process Japanese-language information and (3) high-level human interfaces.

From that perspective, work began in 1988 to develop basic technology for a personal information processing environment architecture ("FRIEND 21:" Future Personal Information Environment Development) that can be used freely and naturally by general users.

-Budget 1.08 billion yen (1.0 billion yen in 1988) Basic Technology Development for FRIEND 21

3. Promotion of information-orientation of industry: The use of information by the industrial field has played a leading role in the use of information in Japan. In the future, however, it will be necessary to go forward with a conversion to information use that goes beyond the framework of the enterprise or the industry, including such things as the architecture of inter-enterprise information processing systems. For that reason, we will formulate "Guidelines for Connection and Use of Computers" on the basis of the "Law concerning the Encouragement of Information Processing," focusing on the following measures:

(a) Promotion of system integration services: To raise the level of the information base of Japan's economy and society, it is essential that the information service industry, which will have the central role in that process, provide system integration services to meet the diversified needs of users.

For that reason, entities that operate information services built and delivered under free maintenance compensation contracts for systems over a certain size will be allowed to set aside a tax-free reserve of a certain proportion (10 percent) of the price of the systems in question as a maintenance compensation reserve fund. System integrators of systems that contribute to strengthening the base of the information industry and of systems with a high "public-utility" factor will receive payments from the Development Bank of Japan.

(b) Encouragement of the construction of a networked society: From the perspective of upgrading and revitalizing Japan's industrial structure and bringing about a highly information oriented society that will lead to a fuller and more comfortable standard of living, the promotion of the networking of information processing and the creation of infrastructure for greater use of information by industry have become urgent tasks.

For that reason, we will devise preferential tax measures for those who acquire network architecture facilities, and will give them low-interest loans from the Development Bank.

-Tax measure Packet switches will be added to the scope of Tax Measures to Encourage Investment in the Energy, Social and Economic Base.

(c) Encouragement of preparation of information processing safety measures: Now that Japan's economy and society are highly dependent on computer systems, assuring the reliability and safety of computer systems is no longer just a problem for companies and industries; it has become an urgent and essential task in terms of the national standard of living.

For that reason, the Development Bank and others will provide financing to strengthen safety measures for the information systems of users, and to create backup centers.

-Public investment portion of 116 billion yen (portion of 110 billion yen Encouragement of Preparation of Information Processing Safety Measures Allocation for encouragement of information use

#### **Regional Revitalization Through Regional Information Use**

1. Promotion of the New Media Community and other concepts: It will be essential, in order to smoothly bring about a highly information-oriented society, to correct the discrepancies in use of information from region to region, and to promote information use that is balanced across the country.

For that reason, we will encourage the spread of the New Media Community concept, which has the purpose of developing and popularizing various information systems suited to the needs of communities in outlying regions, and we will promote regional information use by means of preparation of regional information base facilities (New Media Centers) and active use of the public investment system to encourage regional information use.

(a) Extension of New Media Community concept to application and development regions: Regions to apply model information systems and introduce them in developed form will be designated as New Media Community concept application and development regions, and feasibility studies will be conducted there.

Moreover, the model information systems constructed in the model regions will have their specifications standardized and placed in a database. The spread of the systems to similar regions will further encourage regional information use.

-Budget 40 million yen (50 million yen in 1988) New Media Community Concept

There will also be financing from the Development Bank and the Hokkaido-Tohoku Development Corp., and from the Industrial Investment Special Fund.

(b) Encouragement of preparation of New Media Centers under the Private-Sector Vitality Law: To encourage the preparation of New Media Centers to play a central role in regional information use and to contribute to the industrial and economic development of outlying regions, we will devise assistance measures including tax measures under the Law on Utilizing the Vitality of the Private Sector, and financing for entities that build such facilities from the Development Bank and the Hokkaido-Tohoku Development Corp.

-Public investment portion of 155 billion yen (portion of 145 billion yen in 1988) Preparation of New Media Centers Hokkaido-Tohoku Development Corp. financing

2. Promotion of the information-oriented future cities concept: It will be necessary, in order to encourage the realization of a highly information-oriented society and to promote expansion of domestic demand, to accelerate information-oriented investment in the areas of industry, society and home life.

For that reason, we will establish a field in model cities for creation of advanced information systems to be introduced in readiness for the 21st century. By promoting the creation of network systems for the purpose of comprehensively promoting information use in all areas, we will set off the spread of information systems throughout society.

In FY 1989, as in the previous year, we will devise necessary tax measures and put great effort into the construction of information-oriented future cities.

(a) Survey of creation of information-oriented future cities: We will survey advanced information systems that have control functions like intraregional energy, as well as the functions of collecting, processing and supplying information inside and outside the city. Such systems will form the core of information-oriented future cities.

-Budget 90 million yen (100 million yen in 1988) Survey of Creation of Information-oriented Future Cities

(b) Encouraging the preparation of Area Management Centers under the Private-sector Vitality Law: Information centers that will raise the level of regional control and information processing functions, which will be the core of large-scale regional development adapted to internationalization and the turn to information use (the Information-oriented Future Cities concept), and base facilities such as regional LAN's will be added to the specified facilities of the Law on Utilizing the Vitality of the Private Sector, as base facilities for integrated regional control.

-Public investment portion of 116 billion yen (portion of 110 billion yen in 1988)

Encouragement of Preparation of Information Processing Safety Measures Hokkaido-Tohoku Development Corp. financing

3. Promotion of Hi-Vision Community concept: Because of its characteristics of high resolution and wide viewing angle, it is very important to encourage the smooth popularization of Hi-Vision as the next generation of television, and as a graphic instrument packed with potential for application to various fields of public welfare.

Beginning in FY 1989, we will provide assistance to develop and set up model systems for the use of Hi-Vision in outlying regions.

-Budget 20 million yen (new) Development of Hi-Vision Community Model System

In addition, there will be tax measures and financing from the Development Bank and the Hokkaido-Tohoku Development Corp. and from the Industrial Investment Special Fund.

#### **Promotion of Information-related Technological Research**

For the Japanese economy and society to bring about an energetic, highly information-oriented society and cope with diverse industrial and social needs, unending promotion of technological development will be indispensable.

For that reason, in FY 1989 we will continue to put effort into Fifth Generation Computer R&D, which is indispensable to the progress of information use, R&D on computer-interoperable database systems, and development of high-speed computers for science and technology. We will also begin feasibility studies on new information processing technology, such as neuro-computers.

Moreover, we will make active use of the financing function of the Key Technology Center [KTC], and encourage research and development by R&D companies established with KTC funding.

1. Fifth Generation Computer R&D: We will continually to forcefully implement R&D on the next-generation computer driven by revolutionary technology for artificial intelligence and high-level parallel processing (the Fifth Generation Computer) into the beginning of the 1990's.

In FY 1990, which is the first year of the last phase of the project, we will work toward completion of the total system (prototype system) of the Fifth Generation Computer.

-Budget 6.48 billion yen (5.73 billion yen in 1988) Fifth Generation Computer R&D

2. Development of new information processing technology such as neuro-computers: We will survey new information processing technology such as neuro-computers that apply the functions of the human brain to the information processing mechanisms of the computer.

-Budget 20 million yen (new) Comprehensive Survey Research on New Information Processing Technology such as Neuro-computers

3. Future Personal Information Environment Development (FRIEND 21) (Cited above)

-Budget 1.08 billion yen (1.0 billion yen in 1988) Basic Technology Development for FRIEND 21

4. Development of computer-interoperable database systems (Cited above)

-Budget 1.42 billion yen (1.14 billion yen in 1988) Development of Computer-interoperable Database Systems

5. R&D on high-speed computer system for science and technology: There is a very great need, particularly in the field of science and technology, for high-speed computer systems with capabilities that far exceed those of present general-use computers. We will continue to promote this project, which began in FY 1981, as part of a large project.

-Budget 2.43 billion yen (2.78 billion yen in 1988) Development of High-speed Computer System for Science and Technology

6. New Functional Device R&D: In order to develop revolutionary basic technologies that will break through the limits of technology, and to establish an advanced industrial basis of new technology for the 1990's, we will continue to do R&D on super-lattice devices, three-dimensional circuit devices and bio-devices.

-Budget 1.31 billion yen (1.21 billion yen in 1988) New Functional Devices

7. R&D on superconductive materials and devices: We will engage in the development of superconductive devices with very high speed and new functions, explication of the mechanisms for manifesting high-temperature superconductivity, development of new superconductive materials, and development of innovative processing technology.

-Budget 1.87 billion yen (106 million yen in 1988) Superconductive Devices and Materials

8. Photo-reactive materials: We will continue R&D on photo-reactive materials, the molecular structure of which is reversibly changed by the action of light, that can be used in high-density memory, high-resolution displays, photo-switches and so on.

-Budget 320 million yen (230 million yen in 1988) Photo-reactive Materials

9. Development of diagnostic support systems: We will continue to promote the development of systems to quickly and accurately support decisions on medical diagnosis, treatment and therapy by immediately providing the information needed by doctors.

10. Use of the Key Technology Center: The Key Technology Center has such functions as that of providing the necessary risk money to encourage experimental research on basic technology conducted in the private sector.

In FY 1989 we will continue to use the center to encourage technological development by disbursements and conditional, interest-free loans to the Joint Experimental Research Corp. and the New Media Community Promotion Corp., and will serve as a bridge between those institutions and the national laboratories for research purposes.

-Public investment 26 billion yen (26 billion yen in 1988)  
Industrial Development Special Account Use of Key Technology Center

#### **Cooperation in Information Use by Developing Countries**

In advanced countries, increased use of information processing has become an indispensable foundation of modern industry and society, but information use by developing countries has been markedly delayed. Although they recognize the necessity of information use, they have not made a real start on the conversion because of numerous obstacles in regard to human resources and knowhow.

Against such a backdrop, there is great need for cooperation in information use by the developing countries. Japan will continue to cooperate actively with the developing countries of the Pacific region and elsewhere to bring about the international spread of information processing.

1. Cooperation among neighboring countries in research on machine translation systems: To promote and further develop technological and cultural exchange between Japan and neighboring countries, we will continue last year's project of cooperative research to develop systems for machine translation between Japanese and the Chinese, Thai, Malay and Indonesian languages.

-Budget 640 million yen (330 million yen in 1988)  
Research Cooperation among Neighboring Countries on Machine Translation Systems

2. Cooperation on comprehensive information use in Asia: In FY 1989 we will begin efforts to transfer various information-processing technology to developing countries through joint development of CAI [computer-assisted instruction] to train information-processing technicians.

-Budget 10 million yen (new) Cooperation on Comprehensive Information Use in Asia

3. Promotion of advanced information training and guidance (International Information Cooperation Center project): In order to promote information use by developing countries and to contribute to the development of their economies and industries, we will implement advanced training in Japan to foster technicians to promote information use, and we will send Japanese technicians to those countries to give guidance on information use there.

-Budget 240 billion yen (240 billion yen in 1988) Promotion of Advanced Information Training and Guidance (International Information Cooperation Center project)

#### **Database Preparation**

Databases are, like hardware, software and human resources, one of the pillars supporting an information-oriented society; the preparation of databases is a prerequisite for information use. However, the preparation of databases in Japan lags far behind that in other countries. Preparing them is an urgent task.

To encourage the preparation of databases in Japan, we will devise comprehensive measures on database preparation, including encouragement of database creation in the private sector, encouragement of the creation of public databases, education of distributors, and increased availability to the private sector of databases held by the government.

Moreover, most Japanese databases have been created abroad (Europe and U.S.); we have a perfect import surplus in the world of databases. In order to avoid information friction with the advanced countries, it is necessary for Japan to deploy its own information internationally. Moreover, it is desirable that we cooperate in database preparation not only with the advanced countries, but also with the developing countries whose preparation of databases lags even further behind than our own.

1. Encouragement of database internationalization: Most Japanese databases have been created abroad, and the advanced countries have pointed out that we have been underhanded regarding access to Japanese information. It is also very important from the perspective of developing the economies and industries of developing countries that we provide our information to foreign countries.

Therefore, in FY 1989 we will begin a feasibility study regarding encouragement of the provision of Japan databases to other countries, based on the needs of other countries for our databases.

-Budget portion of 80 million yen (new) Database Preparation

2. Encouragement of creation of important databases: We will implement development and design studies for the creation of databases in fields that are important for the development of the Japanese economy and society, including advanced technology (fine ceramics, new materials etc.), energy and security.

-Budget portion of 80 million yen (portion of 80 million yen in 1988) Database Preparation

3. Encouragement of creation of public databases: We will provide Development Bank of Japan funds for corporations that create the fundamental databases necessary for the future development of industrial and social activity, and we will finance plant and non-plant investment for database projects.

Moreover, we have provided database creation reserve funds to lighten the burden of database preparation and renewal.

(a) Financing database creation costs (Development Bank of Japan financing) The acquisition of equipment and the non-plant costs incurred during database creation by information service operators will be financed.

(b) Funding basic database creation corporations (Development Bank of Japan funding: Corporations that create fundamental bases necessary for industrial and social activity and the development of regional society will receive funding from the Development Bank of Japan.

(c) Database creation reserve fund: Ten percent of total sales will be put aside (entered as a debit) as a reserve fund for financing necessary for database creation; after it has been held 4 years, the amount can be drawn down in equal installments over 4 years (entered as a credit). This reserve fund system will promote database creation.

**IHI Makes Comeback in Weapons Manufacture**  
*43062072a Tokyo ZAIKAI TENBO in Japanese*  
*May 89 pp 174-180*

[Text]

**Domestic Production of Jet Engine With Late President Doko As Voice of Authority**

On 7 August 1945 at the closing stages of the Pacific War, the first Japanese jet aircraft flew in the skies at the naval air base in Kisarazu. Okinawa already had fallen to American forces and Tokyo had also become almost ashes from the indiscriminate bombing by B-29 bombers on 10 March and 25 May. The dropping of the atomic bomb on Hiroshima was the day before on the 6th.

Pushed way into the corner, the Japanese navy was betting all its might on the flight of the jet aircraft "Kitsuka". The body was made by Nakashima Aeroplane and the engine was the domestically produced "Ne-20." Japan had been making an effort to develop jet engines since around 1941 but because of material shortages and lack of trial-manufacture capabilities due to the war, it was not proceeding as hoped. Then in July 1944, the military attache stationed in Germany returned home with data on the jet engine for the Messerschmidt Me-262 twin engine fighter-bomber put in service by the Germans. The important data such as the schematic drawings, however, were being transported by a submarine which was sunk and the drawing brought by the military attache was a scant one-page simple engine cross-section drawing.

Based on this cross-section drawing, which was like a cartoon, the navy was resolved to trial-manufacture the "Ne-20." The navy, whose combined fleet already had been totally destroyed in the sea battle off Leyte, abandoned the construction of ships and tackled the production of the "Ne-20" with all its might. It was the Tokyo Ishikawajima Shipyards that was chosen by the navy to be in charge of trial-manufacture and mass production of jet engines for commercial use also.

Why was the "Ne-20" made at Ishikawajima Shipyards? Koichi Ichida, chief of the Business Planning Department, National Aerospace Development Agency, says that "Reciprocal engines were the main power during the war, but Ishikawajima made steam turbine engines for ships. It is close to a jet engine because of the rotating mechanism, which is different from a piston engine. That is why turbo engines were researched for automobile engines too." Indeed, Nakashima Aeroplane and Mitsubishi Heavy Industries also were directed to do trial-manufacture with the same one-page diagram from Germany, but both were unable to realize it.

The first test flight of the jet "Kitsuka" carrying the "Ne-20" was for 12 minutes at an altitude of 600 meters. The test pilot was Lieutenant Commander Susumu Takaoka. Later he entered the Air Self Defense Force

and advanced to major general. In addition, they had seized a Lockheed F104 fighter and MU-2 multi-purpose aircraft control stick at Mitsubishi Heavy Industries. Also, the person responsible for the technology of the "Ne-20" was Commander Osamu Nagano, who later was the first generation of Ishikawajima Harima Heavy Industries (IHI), head of the Tanashi Plant, and head of the Aircraft Engine Department.

The second test flight of the "Kitsuka" was attempted on 11 August, but it failed on take-off and crashed into the sea with serious damage. There was continuous testing of the next airframe, working into the middle of the night, but four days later on 15 August, Japan accepted the Potsdam Declaration and lost the war.

Of course, everything concerning aircraft, including the "Ne-20," was either destroyed by the Allied Powers or brought back to the United States. Then, for a seven-year period Japan was prohibited from anything related to aviation. Not only research and development, but the path to civil aviation also was closed.

It is a historical fact that the "Ne-20" became the opportunity which gave birth to today's engine manufacturer IHI. They had to surmount another mountain, however, to establish their firm position as an engine manufacturer.

The Japanese occupation policy of the United States changed with the outbreak of the Korean War on 25 June 1950 and aviation was resumed. Military aircraft overhauls and engine repair work suddenly was done under so-called "special procurement" but it was the Fuji Heavy Industries Omiya Plant that was the first to undertake development of jets. As opposed to this, IHI appealed to various companies concerned with the aircraft industry, organized a Jet Engine Joint Research Committee, and received its first lessons in the J-33 from the U.S. Air Force. The J-33 is the engine for the Lockheed T-33 jet trainer and even today, the Air Self Defense Force uses it for training and liaison flights.

Moreover, the Japan Jet Engine Company was established in July 1953 with private financing. In addition to IHI, Fuji Heavy Industries, Fuji Precision, Shin Mitsubishi Heavy Industries, and later Kawasaki Heavy Industries participated. Work began with a trial design of the 3-ton thrust J-1 and 750 kilogram thrust J-2. With the development of the J-3 engine for the Air Self Defense Force T-1 jet trainer, they reached the turning point.

When the resumption of aviation started, IHI by no means had the advantage. U.S. Air Force Japan held bidding for the overhaul of J-33 engines to be done in Japan. IHI was beaten and Kawasaki Heavy Industries received the order. Stirred to action, IHI concluded a technology tieup with General Electric to produce the J-47 engine for the F-86, the mainforce fighter at the time. Though called cooperation, they were begging for



instruction. However, the J-47 was mass-produced and it was the ideal engine for burying the vacuum in technology for the seven-year period after the war.

IHI was quick to the point of being adventurous and completed an engine plant in Tanashi in 1957, but the foresight of President Toshio Doko at that time was a great factor. Informal project teams and an aviation engine preparations office were inaugurated at IHI early in March 1955. The chief of the Preparations Office was Osamu Nagano of the "Ne-20." It was an organization directly under President Doko. However, the abilities of President Doko further matured. In the development of the J-3 domestically produced jet engine, a trial-manufactured type was perfected by 1959 by the Japan Jet Engine Company with joint funding of the five companies mentioned above. However, in actuality, further development in production technology was necessary for mass production. Capital and personnel were necessary for this too. A risk was involved in this. In addition, the opinion of industrial circles and part of the Japan Defense Agency who was the user was that an engine imported from overseas or license-produced was better for the T-1 engine. This was also due to cost efficiency, but a sense of distrust could be seen now and then on the part of the users in that the foreign-made rather than the Japanese-made could be obtained with certainty and were highly serviceable. Based on this background, Mitsubishi Heavy Industries and Kawasaki Heavy Industries both shrunk back from bringing the J-3 into mass production.

At this time, President Doko dared to take a risk. He was determined that "Poor in resources, the Japan of the future can only exist as a state founded on technology. IHI should put all its effort into development of a jet engine which concentrates on advanced technology, now known as 'high tech'." So, on 30 March of that year, he took over the manufacturing rights from Japan Jet Engine, Ltd. Of course, it took him until 1974 to make payments of royalties from the distressed business. If President Doko did not have the determination at that time, IHI probably would not be in its current position with a 70 percent share of jet engines.

In December 1960, the greetings made by Osamu Nagano, who had moved from the Tanashi Plant to head of the Aircraft Engine Department, are interesting in recalling the particulars of that time with the J-3, IHI, and the Defense Agency. "... We embarked on pioneering this field as a kind of earnest prayer. The road ahead was truly full of difficulties. ... First of all, the target was limited to gas turbines or jet engines. Although meager, we were equipped with the top class experience and capability in Japan concerning this. ... Secondly, the results of development efforts from advanced foreign countries, to which Japan could not aspire under present conditions, were introduced. This was probably the only path for Japan's aviation technology, which regrettably was extremely behind, particularly in technology which requires advanced and long-term cultivation such as in engines, to get a handhold on

the world pace. ... We expected to complete the J-3 engine and make it serviceable, but dependence upon imported technology for some time was probably logical in further stretching the results. ... Thirdly, there was the full cooperation of the Japan Defense Agency, the definite consumer at the time, in the development and equipment plan. Taking hold of the defense demand, it was our responsibility to make the maximum use out of it to foster independence...."

The initial thrust of the J-3 for the T-1 trainer was upped from 1200 kilograms to 1550 kilograms, and it was also employed as the booster engine for the D-2J anti-submarine patrol aircraft (twin-engine propeller aircraft) domestically manufactured by Kawasaki Heavy Industries. Two were attached to the mainwing of the P-2J which has little margin in thrust to be used for additional thrust for very low altitude flying and during takeoffs. As a result, 247 J-2 were delivered to the Japan Defense Agency.

It is a digression, but if the jet engine production system had remained as it was in 1959 backed by President Doko, it would have become almost the monopoly of IHI. In 1966, however, the "Takashima memo" was issued by the chief of the Heavy Industries Bureau as the time Misao Takashima was Minister of International Trade and Industry.

With the title "Let's Make Several Companies Manufacturers For The Development of Jet Engine Technology," Mitsubishi Heavy Industries was given domestic manufacture of the JT8D Pratt & Whitney engine for the C-1 tactical transport of the Air Self Defense Force domestically manufactured by Kawasaki Heavy Industries. Mitsubishi built a new engine plant at Komaki for this and now is in charge of production of the JT8D, the Allison T-63 for the OH-6 small helicopter for the Ground Self Defense Force, and Kawasaki Heavy Industries is in charge of production of the T-53 for the HU1B and AH1S tactical helicopters and the Lycoming T-55 for the C-47 transport helicopter.

#### **Company's Technology Concentrated on Development of Engine for T-4**

At present, the sales volume of the Aerospace Division of IHI is 110 billion yen, occupying about a 14 percent share of IHI overall. Within this, 90 percent is aircraft engines. Viewed from the Japan engine industry, IHI has constantly maintained 70 percent and in the case of IHI production of engines as the main contractor, the ratios of IHI, Mitsubishi Heavy Industries and Kawasaki Heavy Industries are distributed six to two to two.

The three main engines handled by IHI are the F-100 for the McDonnell Douglas F-15 Eagle fighter of the Air Self Defense Force, the T-56 of the Lockheed P-3C Orion anti-submarine patrol aircraft of the Maritime Self Defense Force, and the F-3 of the T-4 intermediate trainer of the Air Self Defense Force.

First of all, the F-100 is license produced with Pratt & Whitney at the pace of two to three engines per month. Thrust exceeds 10 tons, a value eight times larger than the weight of the engine. In selection of the third next FX (next generation mainforce fighter), the Japan Defense Agency considered the thrust to weight ratio as one criterion, but this value was over one; that is, the candidates with an engine thrust greater than the weight of the airframe were the F-15 and the General Dynamics F-16 Fighting Falcon. The F-15 has two F-100 engines and the F-16 has one F-100 but in the motive force with the thrust to weight ratio exceeding one, the F-100 has epoch-making large thrust. This was created by the high tech of a high pressure, high temperature engine. For example, the gas temperature at the turbine entrance of the engine reaches 1400 degrees. This 1400 degrees is a high temperature about the same as the melting point of the engine blades made of heat-resistance alloy. For continuous rotation over a long period while demonstrating the required strength and performance within a high temperature just before the melting of this alloy, the newest very advanced technology is needed from the design to the raw materials and furthermore to the processing method. IHI has acquired such high tech in the license production of the U.S. Air Force F-100 jet engine, which commonly is acknowledged as the world's strongest.

Already 280 engines have been delivered, but there is interest in changing the percentage of domestic production. In 1981 when production of the F-100 started, it was about 50 percent (price percentage), but it became 70 percent in 1984, and currently is 80 percent.

The monthly production of the T-56 also is two to three engines, but it is an established turboprop engine. The P-3C which carries it is an airframe that has outstanding anti-submarine operational capability throughout both camps.

The F-3, cited third, is a jet engine for the domestically manufactured T-4 trainer. It is the most noteworthy product of IHI.

This engine, whose official name is F3IHI30, was an extension of the J-3 that President Doko boldly ventured into mass-production development. The engine, which is for small subsonic aircraft, is mounted on the T-4 trainer with upgraded performance over the J-3 of the domestically manufactured T-1 trainer. IHI has developed the XF3-1 engine together with the Third Research Center (in charge of aviation) of the Japan Defense Agency's Technical Research and Development Institute (TRDI) and since around 1977, began development of the "XF3-20" with greater thrust (over 16 tons thrust) as the required performance of the next generation intermediate trainer (T-4 is mass-production name). It all has been in the form of TRDI guidance but with the current

situation in which about 80 percent of the aircraft industry is defense supply, as formerly emphasized by Nagano, head of the Aircraft Engine Department, it is probably natural.

Both in the Pacific War era and the current era, engine development has not changed in requiring more time than airframe development. It is said that it takes five years for an airframe and seven years for an engine, but now it is the fate of engine manufacturers that the airframe has a 10-year handicap on the engine (IHI executive). If there is no airframe for attachment, it comes to naught and a great risk accompanies development in advance by forecasting. When the mass production of the J-3 was called into question, Mitsubishi HI and Kawasaki HI both turned their backs because of this.

The decision of Kawasaki HI to be the major contractor of the T-4 was made in 1981, but the official adoption of the XT3-30 was in October of 1982. That was because of the necessity to win in competition over the Larzac engine jointly developed by France and Germany.

A little more examination of the F-3 is desirable to see the jet engine development technology of IHI.

Regardless of being a trainer, the F-3 engine is required to fly close to the speed of sound and have dog fight maneuverability. Specifically, that means 1) thrust with a climb rate of 3000 meters per minute, 2) a good fuel consumption rate in order to upgrade cruising performance, 3) reliability so that trouble will not occur in engine air breathing even though entering a tail spin in flight training, 4) that it can easily be restarted if the engine stops while flying at high altitudes, and 5) light in weight and small with a large thrust to weight ratio.

The technology team of IHI has shown that it is concentrating all of its knowhow obtained so far with the results of research and past license production of the J-79 (for F-104J, F-4EJ fighters) and F-100 (F-15J) for such required performance. For example, it was thus for 4), making it light in weight and small, commonly a major theme.

First, they reduced as much as possible the number of stages, raising the load of the compressor from the fan at the foremost part of the engine to the top level in the world. They also succeeded in making it small by increasing the burn load factor of the combustor in the mid section and paid attention to details such as employing a mechanism to omit one bearing support frame of the high pressure turbine in the rear. It is also designed to employ as materials titanium, a lightweight alloy, for 23 percent of the overall weight and heat-resistant alloys for 39 percent.

It also conforms to U.S. military standards in durability, and tests were fully conducted concerning foreign substance suction, which is a great enemy of jet engines. For foreign substances, tests were conducted for ice and in

addition, six birds of about 100 grams, also one large bird of 1.3 kilograms, shot at the same speed as the speed of a T-4 during takeoff into the engine running at maximum speed. In all cases, no emergency situation occurred in which the engine exploded or blade fragments damaged the airframe. In other words, "It was designed to have strength on par with the top line fighters in the world concerning durability and damage prevention."

No great trouble with the F-3 engine was generated in flight tests either. The IHI technology team probably "believes it is the result of dissipating troubles one by one since the J-3 at the trial-manufacture stage of the F-3. Last fiscal year, they delivered 136 engines and about 500 F-3 engines are estimated in the next 10 years.

IHI anticipates an expanded version of the F-3 engine and the writer also greatly makes the request of the Japan Defense Agency, who is the user. Domestically manufactured jets are the J-3 engine of the T-1 trainer, the TF40 Adohr engine (joint development of Great Britain and France) of the F-1 fighter (T-2 supersonic trainer), and the F-3 engine of the T-4, following in succession. What has been indicated so far has been a kind of "The T-1 engine has insufficient thrust." and "The F-1 performance once more is deficient." However, this is not due to the design which is the foundation or domestic production technology. American and European military aircraft have incorporated large modification advancements as necessary even if the mass production type has been deployed to units. That is particularly aimed at improving performance by increasing engine thrust, called the I, II, III versions or A, B versions, and are not "a great undertaking" such as the modified F-4 conducted by the Air Self Defense Force. A designer of an aircraft manufacturer laments, "The current situation is that from trial-manufacture up to the mass-produced No. 1, the Japan Defense Agency views as troublesome development expenses, no matter how small. If performance is to be increased later, however, it becomes the manufacturer's own development. In other words, from the manufacturers point of view, once it has been completed, they cannot make an improved type."

If that were thanks to a peaceful Japan whose existence is far from the "serviceability" of war, that would be the end of it, but questions are posed in the thinking of commercial and defense though it be the same aircraft. It is strange to say that "Performance is unsatisfactory. There is doubt of serviceability." of types of aircraft in which a lot of money is spent to develop it domestically and continue mass production without increasing engine performance. It seems to be contrary to the trend of advancement of technology in numerous foreign countries. The concept of using the T-4 as a light attack aircraft in the future has not surfaced, but it was originally included in the basic policy and is fully possible with changes in the international situation and cost effectiveness in operation. Apart from the Diet policy position which is entangled in the follow-on aircraft to

the F-1, consideration should be given to employment of an increased thrust type of the full-scale pure domestically produced F-3 engine and new high tech.

#### **Bright Future For Engine Division That Risked Fate of Company?**

In talking about the technology IHI risked in engines, the FJR710 must be touched upon. The FJR710 is a 5-ton thrust class turbofan engine for intermediate distances developed as a big project of the Ministry of International Trade and Industry's Agency of Industrial Science and Technology and only one engine was produced. Or rather, it is easier to understand that it was the engine for the "ASUKA" STOL test aircraft of the National Aerospace Laboratory which completed a test flight this March. The "ASUKA," which was converted using an Air Self Defense Force C-1 transport as the parent body, had four FJR710 engines mounted on top of the main wing like frog eyes and took off in a scant 500 meters. Since it was after all a test aircraft, making it serviceable did not inherently enter into the calculations. If it were not used in the "ASUKA" which has a unique style, how many Japanese would know about the FJR710? For IHI, however, who did the development and trial-manufacture, it became an engine which should be remembered in the sense of being different again from the Ne-20, J-3, and F-3.

In the 10 year period since 1971, they have trial-manufactured 9 engines and conducted various types of tests, but for tests with high altitude environment conditions, they went to the British Royal Gas Turbine Research Institute in 1982. That was because they have no ground facility which can cool close to the temperature of the stratosphere which is several degrees below zero. They transported two FJR710 engines, including a spare, to Great Britain. The tests went favorably, however, and performance tests were completed with just one engine and it was a happy miscalculation in which they brought back the other engine without unpacking it. The surprised ones were the prestigious Rolls Royce engine staff who were present. Having thought that so far Japan was imitating and that there was a gap in specific production technology and independent development of a jet engine making free use of their own traditions and techniques, they were surprised at IHI technology and at the same time extended their hand as a partner in joint development.

This became the opportunity for the RJ-500 engine that was developed with Japan and Great Britain as equal partners of 50 percent each. It started at the end of 1979, and two engines were trial-manufactured by March 1982 with Rolls Royce for Great Britain and the Japan Aircraft Engine Society comprised of IHI (60 percent), Mitsubishi HI, and Kawasaki HI for Japan as the nucleus of the enterprise. Japan and Great Britain began tests simultaneously and Japan succeeded with the test rotations at IHI's Mizuho Plant.

However, the RJ-500 was shifted from the anticipated 130 people class jet passenger aircraft to the future demand of 150 people class. Major engine manufacturers of the world with the same aim planned the development of a new engine with rather large thrust. It became a competition between GE and Snecma of France, Pratt & Whitney and MTU of Germany, and Rolls Royce and Japan, but the Pratt & Whitney group made a proposal to participate in the Japanese-British joint development program. Ultimately, in March 1983, a five-nation joint development program was signed in Derby in Great Britain, with Japan and Great Britain, Pratt & Whitney, MTU, and Fiat of Italy participating.

This was the V-2500 engine. It is said that the V meant both five nations and victory.

The passenger aircraft on which the V-2500 was scheduled to be mounted at that time was the fifth generation airbus A-320. The instruments in the pilot's cabin of the A-320 are indicated on a display like a television or personal computer screen called a CRT. In addition, the control stick is not like those so far, but is replaced by a small side stick just like a radio control model at the side of the pilot. They were undecided about the new generation B-7J7 engine under planning by Boeing, but the V-2500 also was a favorite candidate.

The apportionment of the joint development was 30 percent each for Rolls Royce and Pratt & Whitney, 23 percent for Japan, 11 percent for MTU, and 6 percent for Fiat. Within the 23 percent for Japan, IHI had 13.75 percent, occupying over half and 2 of the initial 12 V-2500 engines are test running at the Mizuho Plant. The V-2500 was behind the GE group in the start, but was superior in fuel and received orders for 393 engines.

Though small in quantity, an order for 5 LM-2500 gas turbine engines was decided by the Maritime Self Defense Forces at the end of last year for its AEGIS ships. There was especially deep emotion felt by those concerned in so far as IHI formerly had fought and was defeated by Kawasaki HI who proposed the Rolls Royce gas turbine in the face of making the new destroyers gas turbine. The LM-2500 is made by GE and the U.S. Navy also uses it, but originally it was a jumbo passenger jet engine changed to ship use. The changing of military ships to gas turbine is convenient in that they are lightweight and do not require the time from starting up to getting underway like diesel engines.

There are also IHI engines for space. They are varied from an attitude control apogee motor as a propulsion system and that done jointly with Mitsubishi HI for the space station being developed internationally to that for space environment use.

What do they think about Japan, the former shipbuilding kingdom now? One section chief says, "Only Japan has latent capability. There was an age when we anticipated that there would be a time when it would be lively and were too patient. That charge now has come full cycle. Even if future demand should increase, we probably will not be convinced."

What is the future of the jet engine upon which President Doko has risked the fate of the company? "The share within the company has increased to 14 percent. Regardless of when it becomes 20 or 30 percent, it will be good if the company's overall business grows larger and its footing becomes wider."

That is the response, but there is plenty of enthusiasm for the jet engine.

It was not expressed in words, but the IHI manager lineup speaks with eloquence.

Up to the first half of 1955, President Kosaku Inaba was enthusiastic about designing a large turbocharger for diesel engines, irrespective of use for shipbuilding. Vice President Sadao Takahashi is world renowned as an authority on production technology. Simply speaking, those are the facts. The Japanese aircraft industry has few jig tooling experts compared to the United States and Europe. Today it is making the F-100 engine, tomorrow it is the T-56. Usually, work is conducted as efficiently as possible as far as the number of jobs and cost it takes. Vice President Takahashi, who is betting on creating good product quality control on par with Europe and the United States, or rather better than Europe and the United States today, for a long time has been producing results that have opened their eyes. It has become a situation in which the United States has asked for instruction. Many have been nurtured at the Tanashi engine plant. Osamu Nagano, who has firmed up the base of IHI engine technology since the "Ne-20," says that "This much is because it was Takahashi who created the foundation enabling the production of engines at IHI, or rather in Japan."

Then, Masayoshi Hamanaka of the late 20's/early 30's, director of the Aerospace Division, has participated in all postwar engines in the design field.

Though making a balance, it probably foretells which direction IHI will head.

**Construction Begins at Shiga Nuclear Power Plant**  
43063028 Tokyo DENKI TO GASU in Japanese  
Feb 89 pp 3-6

[Article by H. Sato, Nuclear Power Safety Examination Division: "In Regard to the Start of Construction at the Shiga Nuclear Power Plant"]

[Text] On 1 December 1988 the Hokuriku Electric Power Company changed the temporary name of the Noto Nuclear Power Plant to Shiga Nuclear Power Plant and began construction in earnest. In order of construction start this will be Japan's 48th commercial nuclear power plant and the 24th BWR, but it will be the first nuclear power plant for Hokuriku Electric.

In order to plan for the long-term stability of its electric supply, Hokuriku Electric is now promoting the diversification of its power sources and they are pushing ahead with development centered around the Shiga Nuclear Power Station. The Shiga plant will be established in Akazumi in Shigamachi in Hakui County in Ishikawa Prefecture. Output has been set at 540,000 kW after considering the company's power system program, application of supply and demand, etc.

Below I will attempt to offer a general summary of the Shiga Nuclear Power Plant and the circumstances leading up to the beginning of its construction.

### I. Circumstances Leading to the Start of Construction

In 1967 Hokuriku Electric Power announced a plan to build nuclear power plants to be located in the Akazumi district of Shigamachi and the Fukuura district of Togi-machi. However, negotiations with Fukuura in Togi-machi broke down and although they offered additional purchases to the Akazumi district, because of land improvement operations in Akazumi, negotiations were broken off until they decided on substitute land for the prearranged amount of additional purchases. Then, with the impact of the TMI accident negotiations made no progress. In the meantime, although there was opposition from some fishing cooperatives, in 1974 the situation took a favorable turn when Ishikawa Prefecture undertook an ocean survey.

In this way it took 20 years for the Shiga Nuclear Power Plant to go from the decision to build to the start of construction and this kind of long lead time has almost never been seen with other power plants.

Recent major events leading up to construction are as follows:

16 Jun 86	Environmental impact statement submitted
3 Sep 86	First public hearing
18 Dec 86	Building plan approved by the Power Source Development Regulating Council
26 Jan 87	Application for approval to build a nuclear reactor

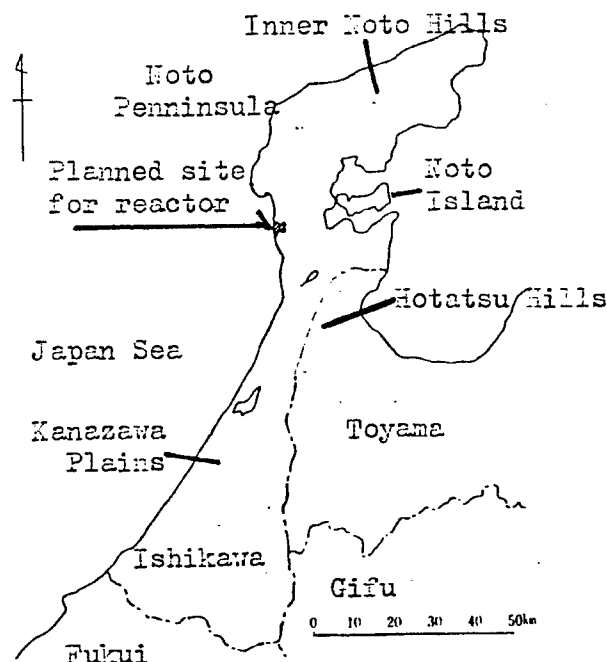


Figure 1. Map of Power Plant Location

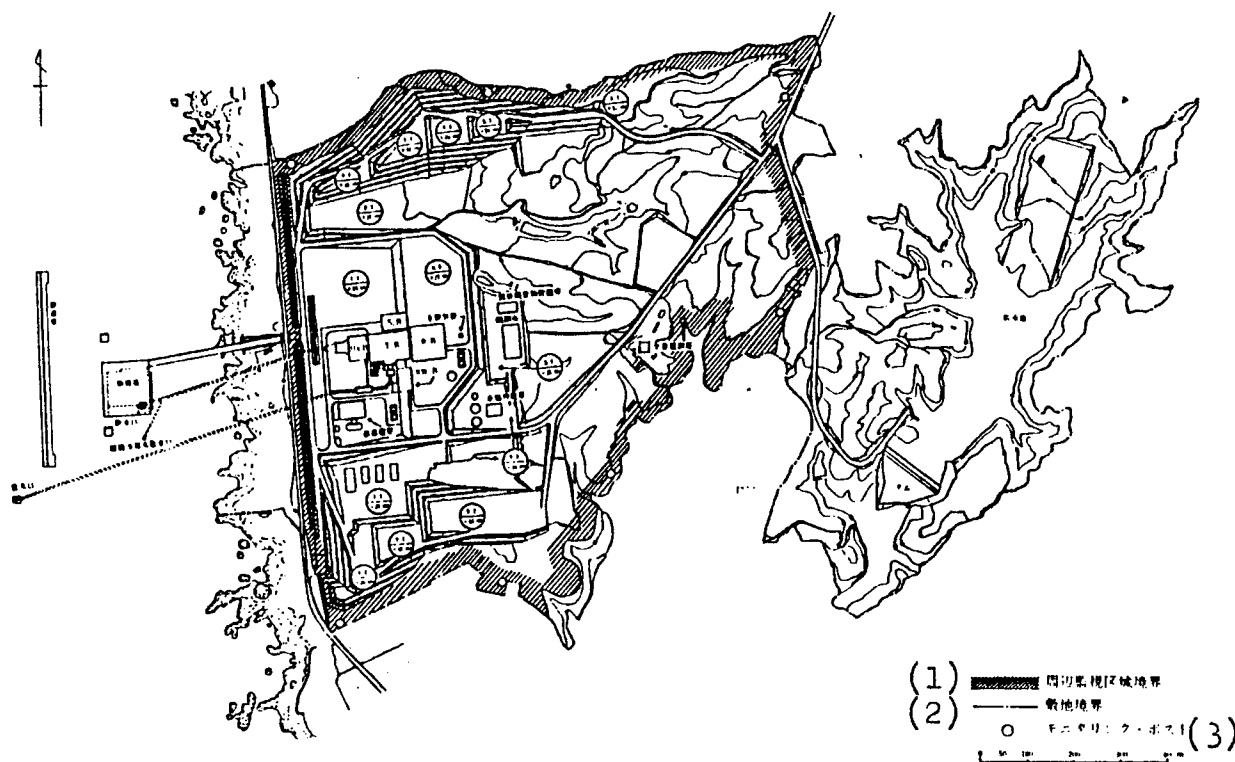
3 Sep 87	Application for approval to alter an electrical structure
24 Feb 88	Second public hearing
22 Aug 88	Approval to build a nuclear reactor
23 Aug 88	Approval to alter an electrical structure
24 Aug 88	Application for initial construction plan permit
2 Nov 88	Approval for initial construction plan
1 Dec 88	Start of construction

### II. General Summary of the Shiga Nuclear Power Plant

As shown in Figure 1, the Shiga Nuclear Power Plant will be located about 50 km to the north of Kanazawashi on the west side of the central part of the Noto peninsula. The entire site faces the Japan Sea and is made up of gently sloping hills approximately 50 m in height.

As shown in Figure 2, the reactor, turbine, and service buildings are in the center of the approximately 1.6 million m<sup>2</sup> site and plans also call for accessory facilities such as an office building, a water supply and treatment building, and switching sites. Sea water for cooling will be run from a water intake built on the south side of the site's wharf, through an intake tunnel and the site's intake water pit, to water recovery equipment. Seawater for cooling which has passed through the water recovery equipment will flow through the discharge pit and tunnel and will be discharged underwater from a discharge exit which will be built about 500 m offshore.

Figure 2. General Diagram of the Power Plant.



Key: R.B = Reactor building; T.B = Turbine building; RW.B = Radioactive waste processing building; S.B = Service building; Hx.B = Sea water heat exchange building; 1. Boundary of peripheral observation region 2. Site boundary 3. Monitoring posts

As can be seen by looking at the diagram, the design of the harbor facilities is a special feature. However, in order to keep changes in the tidal currents and natural shoreline to a minimum, the breakwater was made into an offshore embankment system parallel to the shoreline and the wharf into an off-island system. Furthermore, a water storage pond located on the back side of the power plant will be built with the goal of maintaining the water needed by the power plant and a dam will be built on the Otsubo River which flows through the site.

A prefecture highway runs along the coastline and in no other plant is there a case of a road passing through a power plant site. With the viewpoint of striving for harmony with the environment, Hokuriku Electric decided to greenify the area around the power plant and as a part of this effort, in order that the power plant buildings not be visible from the prefecture highway which passes through the west side of the site, they decided to build an embankment along the highway and to establish a forested zone on top of it.

### III. Special Features of the Facility

The nuclear reactor of the Shiga plant is called a BWR, as boiling water reactors are called. Although the design of

the main facility is basically the same as that of Reactors 3 and 4 at Kashiwazaki-Kariwa, the following special technologies have been introduced.

#### (1) Use of a Reactor Containment Vessel with Improved MARK-I Shape

From the standpoint of improved maintenance and inspectability and reduced exposure, the standardized set-up of the MARK-I improved model or MARK-II improved model reactor containment vessels are generally chosen in improved standard plans for light water reactors.

At the Shiga plant, they have decided on a set-up in which they will use the shape of the MARK-I improved model as reactor containment vessel, in the 500,000 kW class for the first time and adopting the points of view of the improved standardized set-ups for the 800,000 kW and 1.1 million kW classes. In specific terms, with a cylindrical diameter of about 20 m and a height of about 35 m, the main body of the containment vessel will be about 1.6 times the size of existing MARK-I models. They will also build carry-in and carry-out openings

which will enable the establishment of stages within the containment vessel and the breakdown inspection of the main steam release safety valve outside of the containment vessel.

### **(2) The Use of Hafnium Control Rods**

Control of the reaction within the reactor is maintained by adjusting the position of the control rods and regulating the amount of coolant recirculation. In addition to having almost the same nuclear characteristics as existing boron carbide control rods, hafnium control rods which use hafnium rods as their neutron absorption material also possess the superior features listed below. Consequently, at the Shiga plant they decided to use hafnium control rods for a part of the core in addition to existing boron carbide control rods.

- 1) Control rods using hafnium as neutron absorption material have longer lives than those with existing boron carbide.
- 2) With longer lives, it is possible to reduce the number of control rods replaced during periodic inspection.
- 3) By reducing the number of replacement rods, it is possible to reduce the amount of waste generated.

### **(3) Use of the Cementglass Solidification Method**

As a method for solidification within their solid waste treatment system, the Shiga plant will use the cement-glass solidification method whose demonstration characteristics have been confirmed by common electric

power research, whose long-term stability is adequate, and whose volume reduction characteristics are exceptional.

They have decided that among the wastes generated during operation of the power plant, enriched wastes will be made into dry powders using driers. They have decided that mixed combustible solids will be burned in incinerator equipment. They have decided that spent resins will be either made into dry powders or burned.

They have decided that after these dry powders and incineration ashes are made into pellets by a pelletizer, they will be packed into drums and solidified by impregnating them with cementglass.

In addition to having the general properties of inorganic materials (fire resistance, etc.), the cement glass solidifier combines the strength of cement with the fineness of glass. The special features of the hardening reaction are that it occurs at room temperature under normal pressure and that handling is easy.

## **IV. Future Construction Schedule**

Since the actual start of construction in December, they are now eagerly pushing ahead with construction work and in the future after installation and pressure leak testing of the containment vessel, construction of the reactor building, and system performance testing, they are scheduled to begin loading fuel in July 1993 and to begin operation in March 1994.

**Additional Japanese Aid To Chemical Plant**  
34000477 *Lusaka TIMES OF ZAMBIA in English*  
2 Jun 89 p 9

[Text] Japan yesterday pledged to continue helping Nitrogen Chemicals of Zambia (NCZ) if the company continued utilising Japanese technical and project grant aid.

Japanese ambassador to Zambia Mr Toshio Saiki said this in Kafue yesterday when he toured the plant.

He expressed satisfaction with the company's utility of Japanese assistance and grant aid.

During the tour, NCZ general manager Cde Fordie Kambobe told Mr Saiki the rehabilitated Japanese installed plant at the company was performing well.

"Production is so good that in Many alone, we have exceeded the budgeted targets for both April and May," he said.

NCZ had budgeted production of 700 tonnes of ammonium nitrate dense explosive grade for April, 805 tonnes of the same for May and 750 tonnes for June bringing the total to 2,255 tonnes.

The company has already produced 2,224 tonnes.



22161

45

NTIS

ATTN: PROCESS 103  
5285 PORT ROYAL RD  
SPRINGFIELD, VA

22161

This is a U.S. Government publication. Its contents in no way represent the policies, views, or attitudes of the U.S. Government. Users of this publication may cite FBIS or JPRS provided they do so in a manner clearly identifying them as the secondary source.

Foreign Broadcast Information Service (FBIS) and Joint Publications Research Service (JPRS) publications contain political, economic, military, and sociological news, commentary, and other information, as well as scientific and technical data and reports. All information has been obtained from foreign radio and television broadcasts, news agency transmissions, newspapers, books, and periodicals. Items generally are processed from the first or best available source; it should not be inferred that they have been disseminated only in the medium, in the language, or to the area indicated. Items from foreign language sources are translated; those from English-language sources are transcribed, with personal and place names rendered in accordance with FBIS transliteration style.

Headlines, editorial reports, and material enclosed in brackets [ ] are supplied by FBIS/JPRS. Processing indicators such as [Text] or [Excerpts] in the first line of each item indicate how the information was processed from the original. Unfamiliar names rendered phonetically are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear from the original source but have been supplied as appropriate to the context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by the source. Passages in boldface or italics are as published.

## SUBSCRIPTION/PROCUREMENT INFORMATION

The FBIS DAILY REPORT contains current news and information and is published Monday through Friday in eight volumes: China, East Europe, Soviet Union, East Asia, Near East & South Asia, Sub-Saharan Africa, Latin America, and West Europe. Supplements to the DAILY REPORTs may also be available periodically and will be distributed to regular DAILY REPORT subscribers. JPRS publications, which include approximately 50 regional, worldwide, and topical reports, generally contain less time-sensitive information and are published periodically.

Current DAILY REPORTs and JPRS publications are listed in *Government Reports Announcements* issued semimonthly by the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Virginia 22161 and the *Monthly Catalog of U.S. Government Publications* issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

The public may subscribe to either hardcover or microfiche versions of the DAILY REPORTs and JPRS publications through NTIS at the above address or by calling (703) 487-4630. Subscription rates will be

provided by NTIS upon request. Subscriptions are available outside the United States from NTIS or appointed foreign dealers. New subscribers should expect a 30-day delay in receipt of the first issue.

U.S. Government offices may obtain subscriptions to the DAILY REPORTs or JPRS publications (hardcover or microfiche) at no charge through their sponsoring organizations. For additional information or assistance, call FBIS, (202) 338-6735, or write to P.O. Box 2604, Washington, D.C. 20013. Department of Defense consumers are required to submit requests through appropriate command validation channels to DIA, RTS-2C, Washington, D.C. 20301. (Telephone: (202) 373-3771, Autovon: 243-3771.)

Back issues or single copies of the DAILY REPORTs and JPRS publications are not available. Both the DAILY REPORTs and the JPRS publications are on file for public reference at the Library of Congress and at many Federal Depository Libraries. Reference copies may also be seen at many public and university libraries throughout the United States.

